Recipe for chocolate chip cookies:

4 cups flour + 2 cups choc. chips + 2 eggs + 2 tablespoons baking powder + 1 teaspoon vanilla
= 3 dozen cookies

What if I only have 1.4 cups of flour? How many cookies can I make?

Look at the original recipe: what's the ratio between cookies (what I need) and flour (what I have)?

In the recipe, the ratio between cookies and flour is:

$$\frac{\text{3 dozen cookies}}{\text{4 cups flour}}$$

So, I can take the flour I have and multiply it by the ratio above:

$$\text{1.4 cups flour} \times \frac{\text{3 dozen cookies}}{\text{4 cups flour}} = \text{1.05 dozen cookies}$$

RECIPES IN CHEMISTRY:
Writing and using mole ratios:

$N_2 + 3H_2 \rightarrow 2NH_3$

"1 mol of nitrogen reacts with 3 mol of hydrogen to form 2 mol ammonia."

Mole ratio: tells the ratio between 2 substances in a balanced chemical equation.

$$\frac{1 \text{ mol } N_2}{3 \text{ mol } H_2} \qquad \frac{2 \text{ mol } NH_3}{1 \text{ mol } N_2} \qquad \frac{3 \text{ mol } H_2}{2 \text{ mol } NH_3}$$

Using mole ratios to solve problems:

How many moles of ammonia are produced when 0.60 mol of nitrogen reacts with hydrogen?

$N_2 + 3H_2 \rightarrow 2NH_3$

Step 1: identify your known and unknown:

Known: 0.60 mol N_2

Unknown: ? mol NH_3

$N_2 + 3H_2 \rightarrow 2NH_3$

Step 2: Use the unknown and known in the equation to develop a mole ratio:

$$\frac{2 \text{ mol } NH_3}{1 \text{ mol } N_2}$$ (unknown from equation) / (known from equation)

Step 3: multiply the known by the mole ratio:

$$0.60 \text{ mol } N_2 \times \frac{2 \text{ mol } NH_3}{1 \text{ mol } N_2} = 1.2 \text{ mol } NH_3$$

$N_2 + 3H_2 \rightarrow 2NH_3$

How many mol of hydrogen reacts with 2.4 mol nitrogen to form ammonia?

Known: 2.4 mol N_2

Unknown: ? mol H_2

Mole ratio: $\frac{3 \text{ mol } H_2}{1 \text{ mol } N_2}$ $\frac{\text{(unknown from equation)}}{\text{(known from equation)}}$

$$2.4 \text{ mol } N_2 \times \frac{3 \text{ mol } H_2}{1 \text{ mol } N_2} = 7.2 \text{ mol } H_2$$

$4Al + 3O_2 \rightarrow 2Al_2O_3$

How many mol of aluminum are needed to form 7.8 mol aluminum oxide?

Known: 7.8 mol Al_2O_3

Unknown: ? mol Al

Mole ratio: $\frac{4 \text{ mol Al}}{2 \text{ mol } Al_2O_3}$ $\frac{\text{(unknown from equation)}}{\text{(known from equation)}}$

$$7.8 \text{ mol } Al_2O_3 \times \frac{4 \text{ mol Al}}{2 \text{ mol } Al_2O_3} = 15.6 \text{ mol Al}$$

STOICHIOMETRY-Using chemical equations to determine quantities

Solid lithium hydroxide is used in space vehicles to remove exhaled carbon dioxide. The lithium hydroxide reacts with gaseous carbon dioxide to form solid lithium carbonate and liquid water. How many grams of carbon dioxide can be absorbed by 1.00g of lithium hydroxide?

How do we solve this problem?

Step 1: Write a balanced chemical equation:

$$2\,LiOH\,(s) + CO_2\,(g) \dashrightarrow Li_2CO_3\,(s) + H_2O\,(l)$$

Understand that each coefficient represents the number of moles of each substance.

$$2\ LiOH\ (s) + CO_2\ (g) \rightarrow Li_2CO_3\ (s) + H_2O\ (l)$$

Pay attention to the substance and units asked for in the problem.....we need grams of CO_2.

Step 2: Find the ratio between the unknown substance and the known substance in the problem:

$$\text{The mole ratio of } \frac{\text{unknown}}{\text{known}} = \frac{CO_2}{LiOH}$$

$$= \frac{1\ mol\ CO2}{2\ mol\ LiOH}$$

Step 3: Write down the quantity and substance you are starting with in the problem and convert to moles, and multiply by the mole ratio.

$$1.00\ \text{g LiOH} \times \frac{1\ \text{mol}}{23.9\ \text{g}} \times \frac{1\ \text{mol } CO_2}{2\ \text{mol LiOH}} =$$

But we need grams of CO_2, so we must convert moles of CO_2 to grams:

$$1.00\ g\ LiOH \times \frac{1\ mol}{23.9\ g} \times \frac{1\ mol\ CO_2}{2\ mol\ LiOH} \times \frac{44.0g}{1\ mol} =$$

$$0.92\ g\ CO_2$$

Mathematically, the problem is:
1.00/23.9/2 x 44.0 = 0.92

The combustion of carbon monoxide is:

$2CO\ (g) + O_2\ (g) \rightarrow 2CO_2\ (g)$

How many liters of oxygen are required to burn 7.84 L of carbon monoxide?

$$7.84\text{L CO} \times \frac{1\text{ mol}}{22.4\text{ L}} \times \frac{1\text{ mol } O_2}{2\text{ mol CO}} \times \frac{22.4\text{L}}{1\text{ mol}} =$$

3.92 L O_2

Which factors above canceled out?

In a volume-volume problem, 22.4L/mol factors out.

The coefficients in an equation also indicate # of liters.

How many molecules of oxygen are produced by the decomposition of 11.53 g of potassium chlorate?

$$2KClO_3(s) \rightarrow 2KCl + 3O_2$$

$$11.53\ g\ KClO_3 \times \frac{1\ mol}{122.6\ g} \times \frac{3\ mol\ O_2}{2\ mol\ KClO_3} \times \frac{6.02 \times 10^{23}\ molecules}{1\ mol}$$

$$= 8.5 \times 10^{22}\ molecules\ O_2$$

Astronauts depend on these CO_2 "scrubbers" to clean the air they breathe. If the average person exhales 432 L of CO_2 at STP, how many grams of LiOH is needed per person in the scrubbers?

$$2LiOH\ (s) + CO_2\ (g) \rightarrow Li_2CO_3\ (s) + H_2O\ (l)$$

Known: 432 L CO_2

Unknown: grams LiOH

$$432\ L\ CO_2 \times \frac{1\ mol}{22.4\ L} \times \frac{2\ mol\ LiOH}{1\ mol\ CO_2} \times \frac{23.9\ g}{1\ mol} =$$

921.9 g LiOH

Steps in solving stoichiometry problems:

1. Identify known and unknown.

2. Convert known quantity to moles.

3. Multiply by the mole ratio.

moles of unknown/moles of known

4. Convert to needed units by using conversion factors.

Complete problems #39-44 on p. 379. Do your work here: